Heart Research

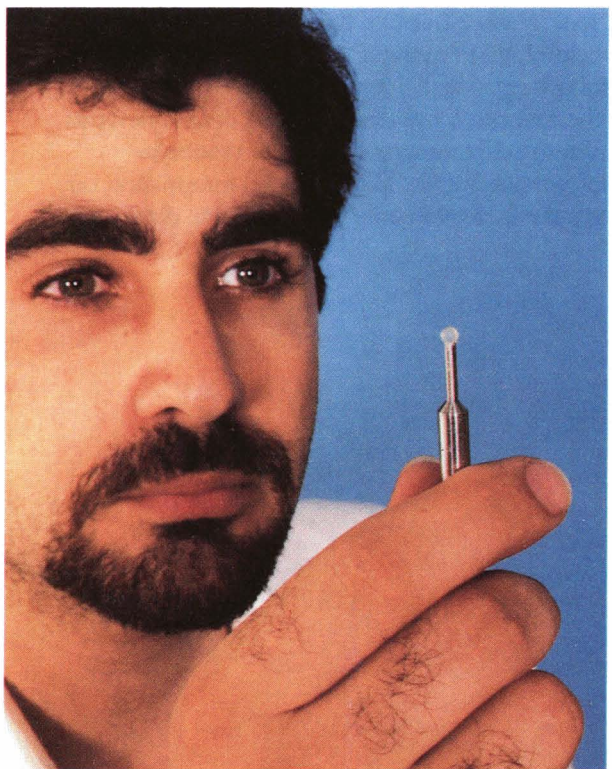
At the University of Pittsburgh School of Medicine, researcher James F. Antaki and colleagues of the Department of Surgery are conducting a study of cardiac biomechanics involving development of a computer model to advance understanding of stress/strain relationships in the heart.

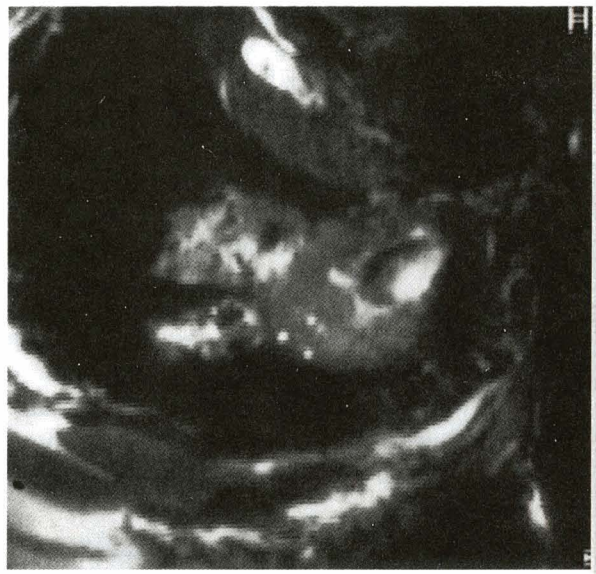
As essential input to the model, it was necessary to supply a full three-dimensional spatial description of the heart surface. The technique of Magnetic Resonance Imaging (MRI) was ideally suited to this task because it is inherently three-dimensional.

In addition to topographic information, the researchers needed a way to visualize and track material points within the heart muscle, some kind of implantable marker that would show up in MRI images as a bright dot against a dark background. Unfortunately, they were unable to find any solid or gel substance that would provide the necessary intensity.

The need, James Antaki explains, was for tiny artificial "eggs" containing a solution of copper sulfate. These heart muscle markers had to be small enough (about two millimeters in diameter) that they would not injure the heart, yet large enough to be seen in the images; they also had to be biocompatible yet tough enough to withstand implantation and the cyclic beating of the muscle.

The group was unable to purchase such a container commercially and efforts to fabricate one failed. Then Antaki read an article in *NASA Tech Briefs,* a publication that describes new technologies available for transfer, about a procedure for making microspheres. Antaki contacted the NASA Industrial Applications Center in Pittsburgh, which in turn put him in touch with Jet Propulsion Laboratory (JPL), the NASA center that had sponsored the technology described in *Tech Briefs*.





JPL provided Antaki a complete set of NASA reports on every aspect of microencapsulation and in one of them — *Apparatus for Producing Hollow Spheres* — Antaki found the solution to his problem. JPL also directed Antaki to the author of the report, Dr. Taylor Wang of Vanderbilt University, who was persuaded to help the Pittsburgh group construct an apparatus for fabricating myocardial markers.

At left, Antaki is inspecting a marker prior to its implantation in an animal heart; the marker is the tiny sphere atop the implantation tool. **Above** is an MRI image of a beating canine heart, showing three markers (dots circled). The Pittsburgh School of Medicine conducted a series of MRI animal heart imaging tests and is using the information provided by the markers to compute strains and associated stresses. The research is expected to lead to improved understanding of how the heart works and the changes that take place when it fails, perhaps enabling developing of improved techniques for detecting and treating diseases of the heart.

A NASA report sparked development of innovative heart research markers